Probing Copper and Copper-Gold Surfaces with Space-Quantized Oxygen Molecular Beams

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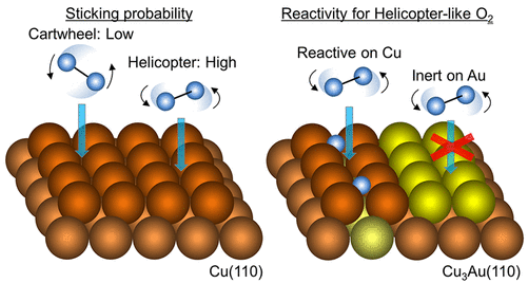
The interaction of O_2 with various metal surfaces induces changes in its chemical stability and reactivity [1]. And the ability to control such processes bears on the chemical economy. Alloying of pristine metals provides one of the simplest and oldest way to do so (cf., e.g., [2-5]). Unraveling the stereochemistry of the processes involved would be imperative for understanding the mechanisms behind these interactions [6]. The dynamics of reactant molecules (esp., the orientation and the movement of molecules in 3D space) play an important role in reactions. The small rotational energy excitations involved (ca. less than a few meV) render the reactants susceptible to dynamical *steering* [1,7-9]. This makes direct comparison with theory rather challenging [1,10]. To directly probe and observe the (polar and azimuthal) orientation dependence of O_2 adsorption on Cu(110) and Cu_3Au(110), we prepared space quantized O_2 molecular beams by sorting the quantum states of the O_2 (cf., e.g., [5] and references therein) via *Richtungsquantelung* (*space quantization*), as first introduced by the 1922 Stern-Gerlach experiment [11,12]. We found that chemisorption proceeded rather favorably with the O-O bond axis oriented parallel (vs. perpendicular) to the surface, and also for O-O bond axis oriented along [001] (vs. along [-110]) (cf., figure below, taken from [5]). Alloying with Au introduced a higher activation barrier to chemisorption. This hinders the surface from further oxidation, and azimuthal anisotropy becomes almost negligible. The presence of Au also prevented cartwheel-like rotating O_2 from further reactions. More details will be presented at the conference.



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